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[Claim(s)]

[Claim 1]Power line automatic Type switchgear which consists of the shape of a tree characterized by comprising the following, a section switch which classifies a power line of an isolated neutral system, and a switch controller which controls opening and closing of said section switch.

A backup power supply which forms operation power under power failure of said power line in said switch controller.

A means to supervise zero phase current of the self-section of a load side of said section switch.

A means to supervise line voltage of two predetermined phases of said power line.

A means to search for phase contrast of said line voltage and said zero phase current.

A means to detect generating of overcurrent by a grounding accident and to memorize said phase contrast when said zero phase current is larger than a set point.

A means to communicate with said switch controller of the section of a next door of a load side of said self-section, and to receive memory information on said phase contrast of the section of a next door of said load side when a circuit breaker of a substation opens wide and said power line fails for power.

A means to judge with a self-section accident when an absolute value of a difference of a memory value of said phase contrast of said self-section and a memory value of said phase contrast of the section of a next door of said load side becomes larger than 90 degrees, and a means to open said section switch before said circuit breaker carries out a reconnection cycle by the judgment of said self-section accident.

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to separation of the accident section by a grounding accident in detail about the shape of a tree (non-loop), and the suitable power line automatic Type switchgear for the Type of the power line of an isolated neutral system.
[0002]
[Description of the Prior Art]Conventionally, in the shape of a tree, and an isolated neutral system, as shown in drawing 19, the power line 4 of a three phase circuit is connected to the secondary of not grounding of the power distribution transformer 2 of the substation 1, via the circuit breaker 3, By the section switch 6 of two or more power line automatic Type switchgears 5, this power line 4 is classified into two or more section #0 of order, #1, #2, #3, and -- from the upper stream side (substation side).
[0003]And each power line automatic Type switchgear 5 consists of the section switch 6 and the switch controller 7 which carries out opening and closing control of this switch 6, and each self-section #1 of the load side of each section switch 6, #2, #3, and -- are removablely connected to a system by the opening and closing control of this switch controller 7.
[0004]If an accident occurs at one section of this system, the circuit breaker 3 of the substation 1 is opened wide and the power line 4 carries out an accident power failure, generally carrying out the third-time closed circuit of the circuit breaker 3 of the substation 1 by the trial line charging explained below, and restoring the healthy section by the side of the upper stream from the accident section conventionally, will be performed.
[0005]For example, if accident point P_1 occurs in section #2, the circuit breaker 3 is wide opened based on overcurrent energization and the power line 4 carries out an accident power failure as shown in drawing 20, When fixed time lapse is carried out from generating of an accident power failure, the circuit breaker 3 carries out a reconnection cycle, and based on the power return by the side of each upper stream, the time limit injection of each section switch 6 is carried out from the section switch 6 of the Mogami style after this reconnection cycle at order.
[0006]If the section switch 6 of section #2 carries out a reconnection cycle by this time limit injection, the circuit breaker 3 will be opened wide again and the power line 4 will fail for power.

[0007]At this time, the section switch 6 of section #2 is wide opened within the accident detection time limit from the power return by the side of that upper stream, and is locked by the opened condition.
[0008]And the circuit breaker 3 carries out a third-time closed circuit after fixed time from a power failure, based on this third-time closed circuit, like the time of a reconnection cycle, the

time limit injection of the section switch 6 of section #1 is carried out first, and section #1 of that load side carries out power return.

[0009]Since the section switch 6 of accident section #2 is locked by the opened condition even if it carries out injection time limit progress from the power return of section #1, this section switch 6 is not thrown in but accident section #2 is separated from a system.

[0010]By separation of this accident section #2, healthy section #0 by the side of that upper stream and #1 carry out power return, and restoration of the healthy section by trial line charging is completed.

[0011]In order to specify the accident section and to take the measures against an accident, etc. conventionally with the so-called base station equipment of supervisory remote control, such as an establishment of an electric power company, and a distribution system control center, Each switch controller 7 is connected to the communication device 11 of the distribution system control center 10 via the communication line 9, and the supervisory equipment 12 of the center 10 is connected to this communication device 11.

[0012]And this supervisory equipment 12 and each switch controller 7 make the supervisory equipment 12 a base station (master station), and make each switch controller 7 a slave station, Information is exchanged by polling communication, the supervisory equipment 12 collects memory information, including the measuring result by the sensors 8, such as a three-phase-circuit current transformer of each switch controller 7, etc., as accident information by the exchange of this information, the accident section is distinguished based on the result of this collection, and the monitor display of a discrimination result, etc. are performed.

[0013]By the way, carry out the third-time closed circuit of the circuit breaker 3 by said trial line charging, and accident section #2 is separated, When restoring healthy section #0 and #1, healthy section #0 and #1 cannot be promptly restored after an accident power failure, but moreover, healthy section #0 and #1 fail for power also by the trial line charging after an accident power failure, and a power failure occurs repeatedly by restoration.

[0014]Then, by the time the circuit breaker 3 after an accident power failure carries out a reconnection cycle so that it may explain below, the section switch 6 of accident section #2 will be wide opened by the supervisory remote control of distribution system control center 10 grade, and restoring healthy section #0 and #1, without performing trial line charging is also devised.

[0015]Namely, if each switch controller 7 is equipped with the backup power supply at the time of system service interruption, such as a battery power supply, for example, an accident occurs in accident point P_1 of drawing 20, as shown in the figure, Each memory information (the information on #1, information on #2, --) is transmitted to the supervisory equipment 12 via the communication line 9 from each switch controller 7 during the accident power failure of the power line 4.

[0016]As accident section #2 is specified with the supervisory equipment 12 based on this transmission and it is shown in drawing 21, The switch controller 7 of accident section #2 is ordered open control via the communication line 9 from the supervisory equipment 12 during an accident power failure, and the section switch 6 of accident section #2 is locked in an opened condition based on these instructions.
[0017]And if the circuit breaker 3 carries out a reconnection cycle, as shown in drawing 22, healthy section #0 and #1 will be restored.
[0018]In drawing 19 - drawing 22, it is shown that the thick line of power line 4 grade is in a charging state.
[0019]
[Problem to be solved by the invention]Since it is the composition of in the case of the power line automatic Type switchgear 5 of said former measuring the current of each phase by the sensor 8, and detecting the occurrence of an accident from change of the size by overcurrent conduction etc., it is difficult to detect the occurrence of the grounding accident of an isolated neutral system actually.
[0020]Namely, earthing impedance of an isolated neutral system is large, ground current is micro current which is a several hundreds milliamperes grade, and the Measurement Division current amount of each phase of the sensor 8 hardly changes depending on this micro current.

[0021]Therefore, even if it supervises change of the size of the current of each phase, the occurrence of a grounding accident cannot be detected but there is a problem which cannot separate the accident section by an automatic Type at the time of the occurrence of a grounding accident.
[0022]When the supervisory remote control of base station equipment of distribution system control center 10 grade restores a healthy section, the base station equipment which equipped this restoration with the large-scale supervisory equipment 12 of the computer configuration which has an automatic determining function of the accident section, etc. is required.
[0023]And it is common for each all prefectures to carry out place installation partly, and, at home, a distribution line network like the power line 4 centers said base station equipment on a substation in this case, for example, Since it is formed in 5-10 km in radius in a city part and is formed in a scale about 50 km in radius in a rural district, While the distance of base station equipment and a distribution line network also produces plentifully the case which surpasses 50 km - 100 km, and the long channel which ties base station equipment and a distribution line network is required, and the communication line 9 becomes very long and requiring great construction of communication equipment, etc., big electric power is needed as communication electric power.
[0024]Even if it adopts wireless communications instead of the cable communications by the

communication line 9, base station equipment of distribution system control center 10 grade requires the communication equipment of the big electric power for base stations.
[0025]If it communicates with the power line carrier system using the power line 4 in order to exclude the communication line 9 therefore, required communication electric power will turn into several megawatts big electric power.
[0026]On the other hand, when restoring a healthy section by the third-time closed circuit of the circuit breaker 3 by trial line charging, this restoration does not take the supervisory remote control of base station equipment, but it is necessary to perform trial line charging, and cannot restore promptly, but, moreover, the power failure accompanying trial line charging occurs.
[0027]This invention, without forming base station equipment of the conventional supervisory remote control, etc. again, Let it be SUBJECT to provide the power line automatic Type switchgear which detects promptly the occurrence of the shape of a difficult tree and the grounding accident of the power line of an isolated neutral system conventionally, separates the accident section automatically, and can restore an upstream healthy section from this section, without performing trial line charging etc.
[0028]
[Means for solving problem]In the power line automatic Type switchgear of this invention in order to solve aforementioned SUBJECT, The backup power supply which forms the operation power under power failure of a power line in a switch controller, A means to supervise the zero phase current of the self-section of the load side of a section switch, and a means to supervise the line voltage of two predetermined phases of a power line, A means to search for the phase contrast of line voltage and zero phase current, and a means to detect generating of the overcurrent by a grounding accident and to memorize said phase contrast when zero phase current is larger than a set point, A means to communicate with the switch controller of the section of the next door of the load side of the self-section, and to receive the memory information on said phase contrast of the section of the next door of a load side when the circuit breaker of a substation opens wide and a power line fails for power, It has a means to judge with a self-section accident when the absolute value of the difference of the memory value of said phase contrast of the self-section and the memory value of said phase contrast of the section of the next door of a load side becomes larger than 90 degrees, and a means to open a section switch before the circuit breaker of a substation carries out a reconnection cycle by the judgment of a self-section accident.
[0029]Therefore, even if a power line carries out an accident power failure, the switch controller operates by a backup power supply.
[0030]On the other hand, if a grounding accident occurs in the power line of the shape of a tree, and an isolated neutral system, the grounding accident current about several hundreds milliamperes will flow into this power line.

[0031]And since this change is easily detectable and zero phase current becomes larger than the predetermined value which is said several hundreds milliamperes extent even if the zero phase current of a non-grounding system is zero and is originally change of aforementioned several hundreds milliamperes, the occurrence of a grounding accident is detected certainly.
[0032]When a grounding accident occurs, zero phase voltage will be generated at an accident point, and, [zero phase current] From an accident point, flow into the upper stream side in the upper stream, i.e., the accident section, and its upper section, flow into the lower stream side from an accident point in the downstream section, and At this time. From this voltage and accident point on the basis of line voltage of two predetermined phases of a system, for example, A, and C phase, a difference with phase contrast with downstream zero phase current is larger than upstream phase contrast, said line voltage, and accident point with zero phase current, and the absolute value of that difference becomes larger than 90 degrees.
[0033]Therefore, when the occurrence of a grounding accident is detected, said phase contrast of the self-section is memorized, By calculating the absolute value of a difference with the memory value of the phase contrast of the section of the next door of said load side which received from the switch controller of the section of the memory value of this phase contrast, and the next door of a load side, since this absolute value becomes larger than 90 degrees, a self-section accident is detected.
[0034]And if it is a self-section accident, before the circuit breaker of a substation carries out a reconnection cycle, the section switch of the self-section will be opened wide and the accident section will be separated automatically.
[0035]By this separation, shortly after the circuit breaker of a substation carries out a reconnection cycle, an upstream healthy section is restored from the accident section.
[0036]In this case, after the accident power failure of a power line, without performing the conventional trial line charging etc., when the circuit breaker of a substation carries out a reconnection cycle, a healthy section is restored promptly.
[0037]And since it is only communicating with the switch controller of the adjoining section of a load side, the base station equipment where the conventional supervisory remote control is large-scale, and its communication equipment are unnecessary.
[0038]Therefore, without having large-scale base station equipment, its communication equipment, etc., without performing the conventional trial line charging etc. with communication with the switch controller of the next section, Conventionally, the occurrence of the shape of a difficult tree and the grounding accident of the power line of an isolated neutral system can be detected, and an upstream healthy section can be promptly restored from the accident section.

[0039]
[Mode for carrying out the invention]It explains with reference to drawing 1 per form thru/or

drawing 18 of operation of this invention. First, the shape of a tree of this form and an isolated neutral system are constituted as shown in drawing 5, and the power line 4 of a three phase circuit is connected to the secondary of the power distribution transformer 2 of the substation 1 via the circuit breaker 3 as usual.

[0040]And the power line 4 is classified into two or more section #0, #1, #2, #3, and -- as usual by the section switch 14 of two or more power line automatic Type switchgears 13.

[0041]Opening and closing control of each section switch 14 is carried out by the switch controller 15 of each automatic Type switchgear 13, and each switch controller 15 communicates with the switch controller 15 of section #2 of the next door of a load side, #3, #4, and -- via the communication line 16.

[0042]Near the load side of each section switch 14, the current sensor 17 of each load side self-section #1, #2, #3, and the three-phase-circuit current transformer composition of -- that measures system current for every phase is formed, and the Measurement Division signal of this sensor 17 is supplied to the switch controller 15 of each automatic Type switchgear 13.

[0043]And since base station equipment of the supervisory remote control of the distribution system control center 10 grade of drawing 19 is not needed for the opening and closing control of each section switch 14 in the case of the earthed neutral system of this form, The distribution system control center 10 of the figure is excluded, and the channel equivalent to the channel between this center 10 and the power line automatic Type switchgear 5 is not formed.

[0044]Next, the section switch 14, the switch controller 15, and the current sensor 17 of each power line automatic Type switchgear 13 are constituted like drawing 1 in which the power line automatic Type switchgear 13 of section #2 was shown.

[0045]And the section switch 14 is provided with the following.

The main circuit contacts 18a, 18b, and 18c interlocked with for every phase of A of the power line 1, B, and C.

The auxiliary contact 19 for a display interlocked with these points of contact 18a-18c.

The closing coil 20 of each points of contact 18a-18c, and 19, the open coil 21.

[0046]The line voltage of two predetermined phases of the power line 4, for example, A, and C phase is processed into single-phase driving power sources (control source) by the transformer 22 for control, and the switch controller 15 is supplied to the power supply input circuit 23, and from this power supply input circuit 23, a power supply is supplied to each part of the inside of a device, and it operates.

[0047][usual / with a healthy system power supply of the power line 4 / in which the power-failure-backup circuit 25 of the backup power supply 24 is connected to the power supply input circuit 23] If the secondary cell 26 of the backup power supply 24 is charged via the power

supply input circuit 23 and the power-failure-backup circuit 25 from the transformer 22 for control and the power line 4 fails for power by a grounding accident etc., Electric power is supplied to a power supply by each part of the inside of a device via the power-failure-backup circuit 25 and the power supply input circuit 23 from the secondary cell 26, and the switch controller 15 operates also during the power failure of the power line 4 by this electric supply.
[0048]And bus combination of the memory 28, the current measuring circuit 29, the voltage measuring circuit 30, the control output circuit 31, the indication input circuit 32, and the serial interface 33 grade for communication is carried out, and the switch controller 15 is formed in the control processing part 27 of microcomputer composition, Accident supervisory control processing of drawing 2 and drawing 3 is performed by the control processing part 27.
[0049]At this time, the Measurement Division signal of the current transformers 34a, 34b, and 34c of A [of the current sensor 17], B, and C each phase is supplied to the current measuring circuit 29, The current measuring circuit 29 calculates the vectorial sum of the current of each phase, and searches for self-section #1, #2, #3, and the zero phase current of --, and the control processing part 27 supervises self-section #1, #2, #3, and the zero phase current of -- using the information on the zero phase current from the current measuring circuit 29.
[0050]The voltage measuring circuit 30 measures the line voltage of A through the control transformer 22, and C phase, and supplies the information to the control processing part 27, and the control processing part 27 of each section #1, #2, #3, and -- supervises the line voltage of each A and C phase.
[0051]And the control processing part 27 searches for the phase contrast of the phase angle of the line voltage of self-section #1, #2, #3, and --, and the phase angle of zero phase current on the basis of the phase of line voltage, Originally, if the zero phase current maintained at zero becomes larger than the set point about several hundreds milliamperes according to a grounding accident, generating of the overcurrent by a grounding accident will be detected and the phase contrast at that time will be memorized in the memory 28.
[0052]For example by well-known digital waveform processing, the size and phase angle of the phase angle of line voltage and zero phase current sample line voltage and zero phase current, respectively, carry out a Fourier integral, and they are acquired by conducting the Fourier analysis of each wave.
[0053]Next, by control of the control processing part 27, the control output circuit 31 drives the closing coil 20 of the section switch 14, and the open coil 21, throws in the section switch 14 and opens them.
[0054]The contact signal of the auxiliary contact 19 for a display is supplied to the indication input circuit 32, and the control processing part 27 grasps the switching condition of the section switch 14 with this contact signal.
[0055]The serial interface 33 is connected to the communication line 16 via communication

MODEM 35, The switch controller 15 of each section #1, #2, #3, and -- communicates with the switch controller 15 of section (henceforth the load side following section) #2 of the next door of each load side, #3, #4, and -- via the communication line 16.

[0056]and the time of the circuit breaker 3 of the substation 1 opening wide, and the power line 4 failing for power with the control processing part 27, the serial interface 32, and communication MODEM 35, -- a load side -- communicating with the switch controller 15 of next the section -- a load side -- a means to receive the information on the phase contrast memorized by the memory 28 of next the section is formed.

[0057]the memory value of said phase contrast of the self-section which the control processing part 27 memorized in the memory 28 and a load side, when the absolute value of a difference with the memory value of said phase contrast of next the section becomes larger than 90 degrees, [a means to judge with a self-section accident] [form and] Before the circuit breaker 3 carries out a reconnection cycle by the judgment of a self-section accident with the control output circuit 31 and the open coil 21, a means to open the section switch 14 is formed.

[0058]Below, accident supervisory control processing of the control processing part 27 is explained. First, after resetting the memory 28 by initial setting of step S_1 of drawing 2, Based on the measuring result of the voltage measuring circuit 30, the phase angle of the present line voltage between A and C phase is grasped by step S_2, It is distinguished by step S_5 whether based on the time of Measurement Division of the current measuring circuit 30, it is larger than the set point of self-section #1, #2, #3, and -- in which the size (absolute value) and phase angle of zero phase current are searched for, and this zero phase current is a several hundreds milliamperes grade by step S_3 and S_4.

[0059]And zero phase current is usually smaller than a set point, said line voltage is healthy, since system voltage has not disappeared, either, step S_4 and S_5 are passed by negation (NO), it returns to step S_2, and the occurrence of a grounding accident is supervised by the loop of step S_2 - S_5.

[0060]If a grounding accident next occurs in accident point P_2 of section #2 as shown, for example in drawing 6, zero phase current will become larger than a set point.

[0061]At this time, it shifts to step S_4 or step S_{6a}, and the phase contrast of that line voltage and zero phase current is searched for on the basis of the phase of the line voltage between A and C phase, and this phase contrast is written in the memory 28, and is memorized.

[0062]And it returns from step S_5 to step S_2, memory of the memory 28 is updated, and the phase contrast of line voltage just before the power line 4 fails for power according to a grounding accident in the memory 28, and zero phase current is memorized until the circuit

breaker 3 of the substation 1 is wide opened by overcurrent energization etc. and the power line 4 fails for power.

[0063]In order to detect disappearance of the overcurrent accompanying the power return of a system and to perform memory elimination of the memory 28 in the cases, such as an instant accident, the initial value (set point) of disappearance detection time N_n is set to a reset count memory by step S_{6b}.

[0064]And if disappearance of overcurrent is detected by step S_4, N_n of a reset count memory will be counted down every [1] by sub step S_a, S_b, S_c, and S_{6c} that consists of S_d, If time N_n is set to 0, the memory value of the phase contrast of the memory 28 will be eliminated.

[0065]On the other hand, if an accident continues and the power line 4 fails for power, said phase contrast will be memorized in the memory 28, and it will shift to step S_7 of drawing 3 from step S_5.

[0066]And zero phase current is larger than a set point, if the grounding accident is continuing, it will shift to step $S_{8\text{from step } S_7}$, a built-in timer will be started, and load side following section #2, #3, #4, and call stand-by-time nickel (=N_1, N_2, N_3, --) (second) of -- will be measured.

[0067]this stand-by-time nickel -- each switch controller 15 -- a load side, [time to call the switch controller 15 of next the section and receive information] [shift and] It is set up in order to prevent the collision of the information by common use of the communication line 16, and in this embodiment, in order to perform a call sequentially from the switch controller 15 of section #1 of the Mogami style, it is set as $N_1<N_2<N_3$--.

[0068]And if the existence of disappearance of system voltage is judged by step S_9 and continuation of a power failure is checked, The call from the switch controller 15 of the section (henceforth [upper stream side] next the section) of the next door of the upper stream side is supervised until it calls by the loop which returns to step S_{10} and step $S_{9\text{from } S_{12}}$ and stand-by-time nickel passes.

[0069]If a upper stream side is called from the switch controller 15 of next the section during this surveillance, the memory information on the memory 28 will be read by step S_{11}, and a upper stream side will transmit the off-hook signal (reply signal) based on this memory information to the switch controller 15 of next the section.

[0070]furthermore -- shifting to step $S_{13\text{from step } S_{12}}$, if call stand-by-time nickel passes -- a load side, [the switch controller 15 of next the section] [the call of overcurrent information] [send out and (transmission)] the load side based on this call, if the off-hook signal from the

switch controller 15 of next the section is received, the load side which shifted to step S_{15} from step S_{14}, and was received with the memory value of said phase contrast of the self-section of the memory 28 by this step S_{15} -- the absolute value of a difference with the memory value of said phase contrast of next the section is calculated, and the existence of a self-section accident is judged by whether this absolute value is greater than 90 degrees.

[0071]And when a grounding accident occurs in the self-section, it becomes larger than 90 degrees, and at this time, the absolute value of said difference shifts to step S_{16} from step S_{15}, carries out the energization drive of the open coil 21, locks the section switch 14 of the self-section in an opened condition, and separates the accident section (self-section) from a system.

[0072]When it judges with a self-section accident, it shifts to step S_{17} from step S_{16}, and when it judges with other section accidents by step S_{15}, it shifts to step S_{17} from step S_{15}.

[0073]And if a upper stream side supervises the call from the switch controller 15 of next the section by the loop of step S_{18} - S_{20} and a call is detected until system voltage will be restored by the reconnection cycle of the circuit breaker 3 of the substation 1, etc., if continuation of a power failure is checked by step S_{17}, an off-hook signal is **(ed), If system voltage is restored, it will return from step S_{20} to step S_1 of drawing 2.

[0074]Also when the power return of system voltage is detected by step S_9 and S_{17}, it returns to step S_1 of drawing 2.

[0075]Therefore, when the power line 4 carried out the accident power failure according to the grounding accident, the section switch 14 of the accident section is locked by the opened condition, the accident section is separated automatically and reclosing of the circuit breaker 3 of the substation 1 is carried out during this power failure, each upstream healthy section is restored from the self-section.

[0076]Below, in the distribution system of drawing 5, operation of the whole system as shown in drawing 6, when a grounding accident occurs in accident point P_2 of section #2 is explained with reference to the timing chart of drawing 4.

[0077]First, as a grounding accident occurs in accident point P_2 of section #2 in t_1, it opens wide to t_2 by a timing action with the suitable circuit breaker 3 of the substation 1 and it is shown in (a) of drawing 4, If the system voltage (distribution line voltage) of the power line 4 will disappear and it will be from a state with voltage in a state without voltage, i.e., a power failure, As for each section #1 in front of a power failure, #2, #3, and --, zero phase current

becomes larger than a set point, and as shown in (b) of the figure, (f), (j), and (n), the phase contrast of each section #1, #2, #3, and the line voltage of the above [the switch controller 15 / memory / 28] and zero phase current of -- is memorized.

[0078]If the timer of each switch controller 15 operates simultaneously with the accident power failure of t_2, it calls from t_2 and stand-by-time N_1 passes, As shown in (c) of drawing 4, the switch controller 15 of section #1 transmits a call signal to the switch controller 15 of load side following section #2, Based on reception of this call signal shown in (h) of the figure, as shown in (g) of the figure, the switch controller 15 of section #2 reads the memory information on the memory 28 (information on #2), and a upper stream side transmits an off-hook signal to the switch controller 15 of section [next] #1.

[0079]And the switch controller 15 of section #1 calculates the absolute value of a difference with the memory value of said phase contrast of received load side following section #2 which is shown in (d) of the memory value of said phase contrast of self-section #1 of the memory 28, and drawing 4.

[0080]If both the zero phase current of section #1 in front of a power failure and #2 flows into the upper stream and sets phase contrast of each zero phase current over line voltage to theta (#1) and theta (#2) at this time, as shown in drawing 7, the phase contrast theta (#1) and theta of section #1 and #2 (#2) will be [both] about +45 degrees.

[0081]Therefore, the absolute value of the difference of the phase contrast theta (#1) and theta of both sections #1 and #2 (#2) becomes smaller than 90 degrees, and it judges with the switch controller 15 of section #1 identifying that self-section #1 is not the accident section, and being other section accidents.

[0082]And since the switch controller 15 does not lock the section switch 14 in an opened condition when judging other section accidents, the section switch 14 of section #1 is maintained at an injection state as shown in (e) of drawing 4.

[0083]If it calls from t_2 and stand-by-time N_2 next passes, as shown in (g) of drawing 4, As the switch controller 15 of section #2 transmits a call signal to the switch controller 15 of load side following section #3 and the switch controller 15 of section #3 shows (k) of the figure based on reception of this call signal shown in (l) of the figure, The memory information on the memory 28 (information on #3) is read, and a upper stream side transmits an off-hook signal to the switch controller 15 of section [next] #2.

[0084]And the switch controller 15 of section #2 calculates the absolute value of a difference with the memory value of said phase contrast of received load side following section #3 which is shown in (h) of the memory value of said phase contrast of self-section #2 of the memory 28, and drawing 4.

[0085]At this time, the zero phase current of section #2 in front of a power failure will flow into the upper stream side, the zero phase current of section #3 flows into the lower stream side,

and if each phase contrast is set to theta (#2) and theta (#3), as shown in drawing 8, about 180 degrees of phase contrast theta (#2) and theta (#3) will shift, and it will become each +45 degrees-135 degrees.

[0086]Therefore, the absolute value of the difference of the phase contrast theta (#2) and theta of both sections #2 and #3 (#3) becomes larger than 90 degrees, and it judges with the switch controller 15 of section #2 identifying that self-section #2 is the accident section, and being a self-section accident.

[0087]And based on the judgment of a self-section accident, the switch controller 15 of section #2 locks the section switch 14 of self-section #2 in an opened condition, as shown in (i) of drawing 4, and it separates section #2 from a system.

[0088]If it calls from t_2 and stand-by-time N_3 next passes, as shown in (k) of drawing 4, the switch controller 15 of section #3 will transmit a call signal to the switch controller 15 of load side following section #4, and it will operate like the switch controller 15 of section #1 and #2.

[0089]when both the zero phase current of both sections #3 in front of a power failure and #4 flows into the lower stream side and sets phase contrast over each line voltage to theta (#3) and theta (#4) at this time, it is shown in drawing 9 -- as -- the phase contrast theta (#3) and theta of both sections #3 and #4 (#4) -- both -- about -- it becomes -135 degree.

[0090]Therefore, the absolute value of the difference of the phase contrast theta (#3) and theta of both sections #3 and #4 (#4) becomes smaller than 90 degrees, and, [the switch controller 15 of section #3] It judges with their being other section accidents like the switch controller 15 of section #1, and based on this judgment, the section switch 14 of section #3 is maintained at an injection state, as shown in (m) of drawing 4.

[0091]If it calls from t_2 and stand-by-time N_4 passes, as shown in (o) of drawing 4, The switch controller 15 of section #4 transmits a call signal to the switch controller 15 of load side following section #5, receive the off-hook signal of section #5 shown in (p) of the figure based on this call, and At this time. Since said phase contrast of section #4 and #5 also becomes it being almost equal and being the same as that of drawing 9, the switch controller 15 of section #4 is also judged to be other section accidents, and as shown in (q) of the figure, the section switch 14 of section #4 is also maintained at an injection state based on this judgment.

[0092]Henceforth, 15 as well as the switch controller 15 of each remaining switch controllers#3, #4, and #5 operates, judges all to be other section accidents, and holds each section switch 14 in the injection state.

[0093]Therefore, during the accident power failure of the power line 4 before the reclosing of the circuit breaker 3 of the substation 1, as shown in drawing 10, only the section switch 14 of accident section #2 is locked by the opened condition by open control of the arrow line of the switch controller 15, and accident section #2 is automatically separated from a system.

[0094]Therefore, shortly after the circuit breaker 3 carries out a reconnection cycle, a re-power

failure like [in the case of being the conventional trial line charging] does not occur, but as shown in drawing 11, healthy section #0 of the upper stream and #1 are restored from accident section #2.

[0095]An address is set to each switch controller 15, respectively, and communication between the switch controllers 15 is performed by the signal format explained below, for example.

[0096]First, as an aforementioned call signal and off-hook signal are formed in the frame configuration of drawing 12 (a) and (b) like the case of general digital transmission and a call signal is shown in the figure (a), As it consists of an area of address AD_1 [of the synchronizing signal SYNC of a head to order, and the partner point], address AD_2 [of a transmitting agency], information kind ID, and information (data) DAT_1, and ending flag END and an off-hook signal is shown in the figure (b), It consists of an area of address AD_1 [of the synchronizing signal SYNC of a head to order, and the partner point], address AD_2 [of a transmitting agency], information kind ID, and information (data) DAT_2, information (data) DAT_3, and ending flag END.

[0097]Each area consists of the start bit st, the 8-bit information data, the stop bit sp, and parity bit pt, respectively, as shown in drawing 13, the start bit st is the logic 0 and the stop bit sp is the logic 1.

[0098]And 8 bits of the information data on the area of information kind ID are called (call signal), and comes to be shown in drawing 14 according to Acknowledge (off-hook signal).

[0099]8 bits of the information data on the area of information DAT_1 of a call signal come to be shown in drawing 15 according to the contents.

[0100]As shown in drawing 16 (a), [each bit b_0 of the information data on the area of information DAT_2 of an off-hook signal, b_1, --, b_7] The ON OFF (switch state) of the section switch 14 of the self-section, the existence of system voltage (those with voltage), It is assigned to presenting of the existence (those with overcurrent) of overcurrent information, --, a response indication (Acknowledge is good), As shown in the figure (b), [each bit b_0 of the information data on the area of information DAT_2 assigned to the information transmission of phase contrast, b_1, --, b_7] Most significant bit b_0 is used for a positive and negative sign bit, and it is used for the numerical value of the phase contrast whose remaining 7bitb_1 - b_7 are 0 degree - 180 degrees of a 2-degree gap, and becomes an absolute value of phase contrast with actual twice of the numerical value of this 7bitb_1 - b_7.

[0101]As for bit b_0 of drawing 16 (a), the logic 1 and 0 corresponds to ON and OFF, as for bit

b_1, the logic 1 and 0 corresponds to ** of voltage, and nothing, and, as for bit b_2, the logic 1 and 0 corresponds to ** of overcurrent information, and nothing.

[0102]The call signal to the switch controller 15 of load side following section #2, and the off-hook signal over this call signal from the switch controller 15 of above section #1 Therefore, (a) of drawing 17, It comes to be shown in (b) and the call signal from the switch controller 15 to the switch controller 15 of load side following section #3 of section #2 and the off-hook signal over this call signal come to be shown in (a) of drawing 18, and (b).

[0103]And each section #1 through the communication line 16, #2, #3, the switch controller 15 and each load side following section #2 of --, #3, #4, and -- with communication between the switch controllers 15, Since the section switch 14 of accident section #2 is locked by the opened condition and accident section #2 is separated from a system during the accident power failure of the power line 4, there is no power failure like [in the case of performing the conventional trial line charging] repeatedly, and healthy section #0 and #1 carry out power return promptly by the reconnection cycle of the circuit breaker 3.

[0104]Base station equipment of supervisory remote control like the distribution system control center 10 of conventional drawing 19 is unnecessary, the communication line from the power line 1 to base station equipment, etc. can be excluded, and power return of healthy section #0 and #1 can be carried out promptly, In this case, since the comparatively short-distance communication between the switch controllers 15 of the next section may be sufficient, it is more remarkably [than the case where communication electric power communicates with said base station equipment] few, and ends.

[0105]And exclude the communication line 16 and a radio-transmission-and-reception function is added to each switch controller 15, Communication between the switch controllers 15 may be made into wireless communications, in this case, several kilowatts small power may be sufficient as uncommunicated electric power, for example, it can be formed very inexpensive and small using the small modem for transceivers of specific small power wireless.

[0106]The communication line 16 is excluded, it may be made to communicate with a power line carrier system, and required communication electric power becomes less than before substantially also in this case.

[0107]And, of course, it is applicable to a domestic distribution system also at an overseas distribution system.

[0108]An internal configuration, a communication format, etc. of the switch controller 15 are not restricted to the thing of this embodiment.

[0109]Two predetermined phases of it being except A and C phase are natural, and the power line 4 is not limited to a three phase circuit.

[0110]

[Effect of the Invention]This invention generates the effect indicated below. During the accident

power failure of the power line 4, it can operate by the backup power supply 24, and the occurrence of the shape of a tree and the grounding accident of the power line 4 of an isolated neutral system can be certainly detected from that change based on the surveillance of the zero phase current of the self-section at this time.

[0111]When a grounding accident occurs, from the accident point measured on the basis of the line voltage of two predetermined phases, for example, A, and C phase The phase contrast of said upstream line voltage and zero phase current, Since the difference of the same downstream line voltage and the phase contrast of zero phase current becomes larger than **90 degrees from an accident point and the absolute value becomes larger than 90 degrees, By calculating the absolute value of a difference with the memory value of the phase contrast of the section of the next door of said load side which received from the switch controller 15 of the section of the memory value of said phase contrast of the self-section, and the next door of a load side, since this absolute value becomes larger than 90 degrees, a self-section accident is detectable.

[0112]And since the section switch 14 of the self-section can be opened wide and the accident section can be automatically separated, before the circuit breaker 3 of the substation 1 carries out a reconnection cycle if it is a self-section accident, shortly after the circuit breaker 3 carries out a reconnection cycle, an upstream healthy section can be restored from the accident section.

[0113]In this case, since a healthy section can be promptly restored by the time the circuit breaker 3 of the substation 1 carries out a reconnection cycle, and it is moreover only communicating with the switch controller of the adjoining section of a load side, without performing the conventional trial line charging etc. after the accident power failure of the power line 4, The base station equipment where the conventional supervisory remote control is large-scale, and its communication equipment are unnecessary.

[0114]Therefore, without having large-scale base station equipment, its communication equipment, etc., without performing the conventional trial line charging etc. with communication with the switch controller 15 of the next section, Conventionally, the occurrence of the shape of a difficult tree and the grounding accident of the power line 4 of an isolated neutral system can be detected, and an upstream healthy section can be promptly restored from the accident section.

[Brief Description of the Drawings]

[Drawing 1]It is a circuit block figure of one form of operation of this invention.

[Drawing 2]It is the 1st flow chart for explanation of drawing 1 of operation.

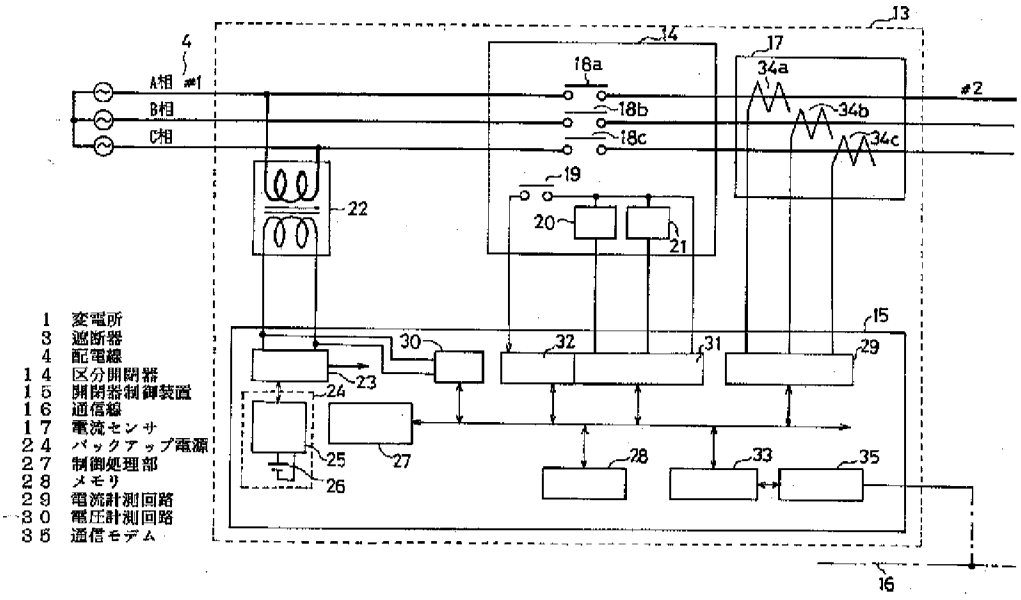
[Drawing 3]It is the 2nd flow chart for explanation of drawing 1 of operation.
[Drawing 4](a) - (q) is a timing chart for explanation of operation when a grounding accident occurs in the power line in which the switch controller of drawing 1 was formed.
[Drawing 5]It is a system diagram under energization of the distribution system in which the switch controller of drawing 1 was formed.
[Drawing 6]It is a system diagram at the time of the accident power failure of the distribution system of drawing 5.
[Drawing 7]It is an explanatory view of the accident section judgment of the switch controller of section #1 of drawing 6.
[Drawing 8]It is an explanatory view of the accident section judgment of the switch controller of section #2 of drawing 6.
[Drawing 9]It is an explanatory view of the accident section judgment of the switch controller of section #3 of drawing 6.
[Drawing 10]It is a system diagram for separation explanation of the accident section of the distribution system of drawing 5.
[Drawing 11]It is a system diagram at the time of the power return of the distribution system of drawing 5.
[Drawing 12](a) and (b) are the explanatory views of a communication format of the call signal of the switch controller of drawing 1, and an off-hook signal.
[Drawing 13]It is a composition explanatory view of each area of a communication format of drawing 12.
[Drawing 14]It is an explanatory view of a part of information content of a communication format of drawing 12.
[Drawing 15]It is an explanatory view of a part of information content at the time of the call signal of a communication format of drawing 12.
[Drawing 16](a) and (b) are the explanatory views of a part of information content at the time of the off-hook signal of a communication format of drawing 12, respectively.
[Drawing 17](a) and (b) are the explanatory views of the call signal of the switch controller of section #1 of drawing 6, and an off-hook signal.
[Drawing 18](a) and (b) are the explanatory views of the call signal of the switch controller of section #2 of drawing 6, and an off-hook signal.
[Drawing 19]It is a system diagram under energization of a system conventionally which has base station equipment.
[Drawing 20]It is a system diagram at the time of the accident power failure of the conventional system of drawing 19.
[Drawing 21]It is a system diagram for separation explanation of the accident section of the conventional system of drawing 19.

[Drawing 22]It is a system diagram at the time of the power return of the conventional system of drawing 19.

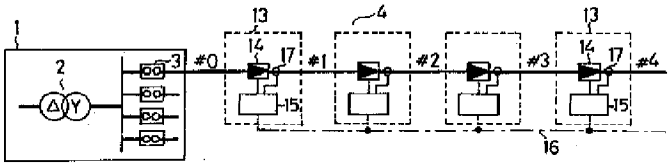
[Explanations of letters or numerals]

1 Substation
3 Circuit breaker
4 Power line
14 Section switch
15 Switch controller
16 Communication line
17 Current sensor
24 Backup power supply
27 Control processing part
28 Memory
29 Current measuring circuit
30 Voltage measuring circuit
35 Communication MODEM

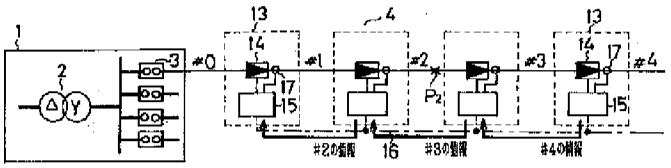
[Drawing 1]



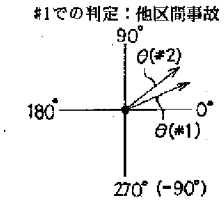
[Drawing 5]



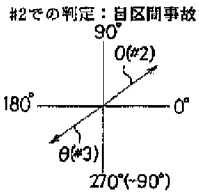
[Drawing 6]



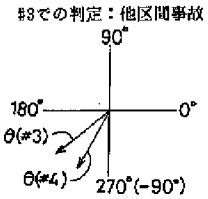
[Drawing 7]



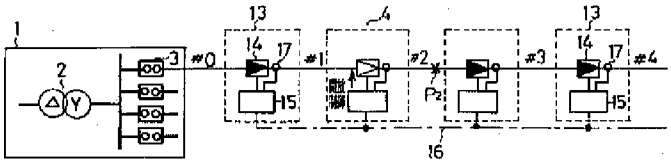
[Drawing 8]



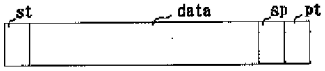
[Drawing 9]



[Drawing 10]



[Drawing 13]



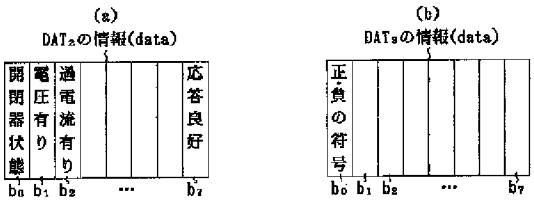
[Drawing 14]

情報種別(ID)の内容	情報(data)
呼出し	00000001
応答	00000010

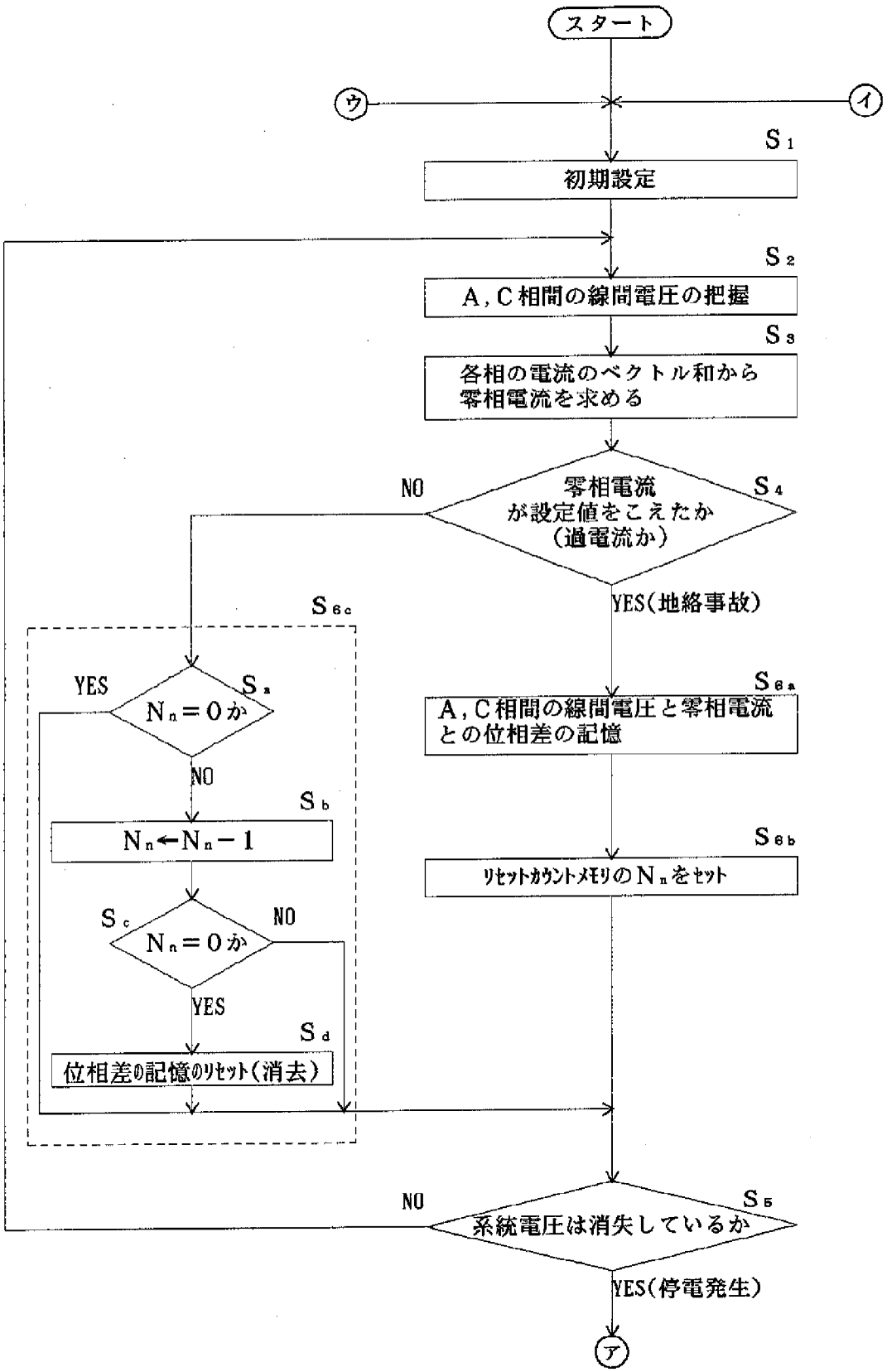
[Drawing 15]

DAT1の内容	情報(data)
開閉器投入指令	00000001
開閉器開放指令	00000010
状態情報要求	00000011

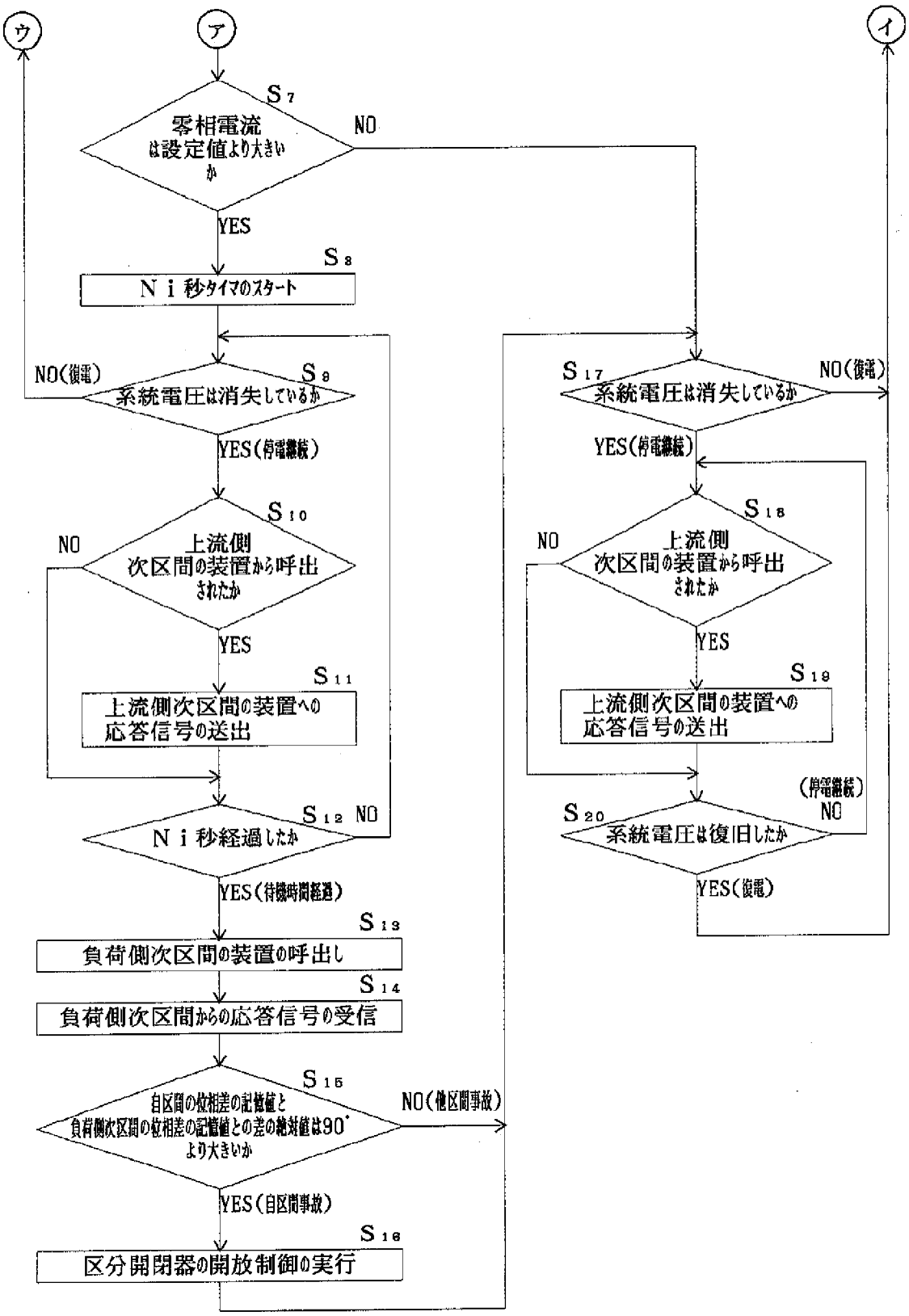
[Drawing 16]



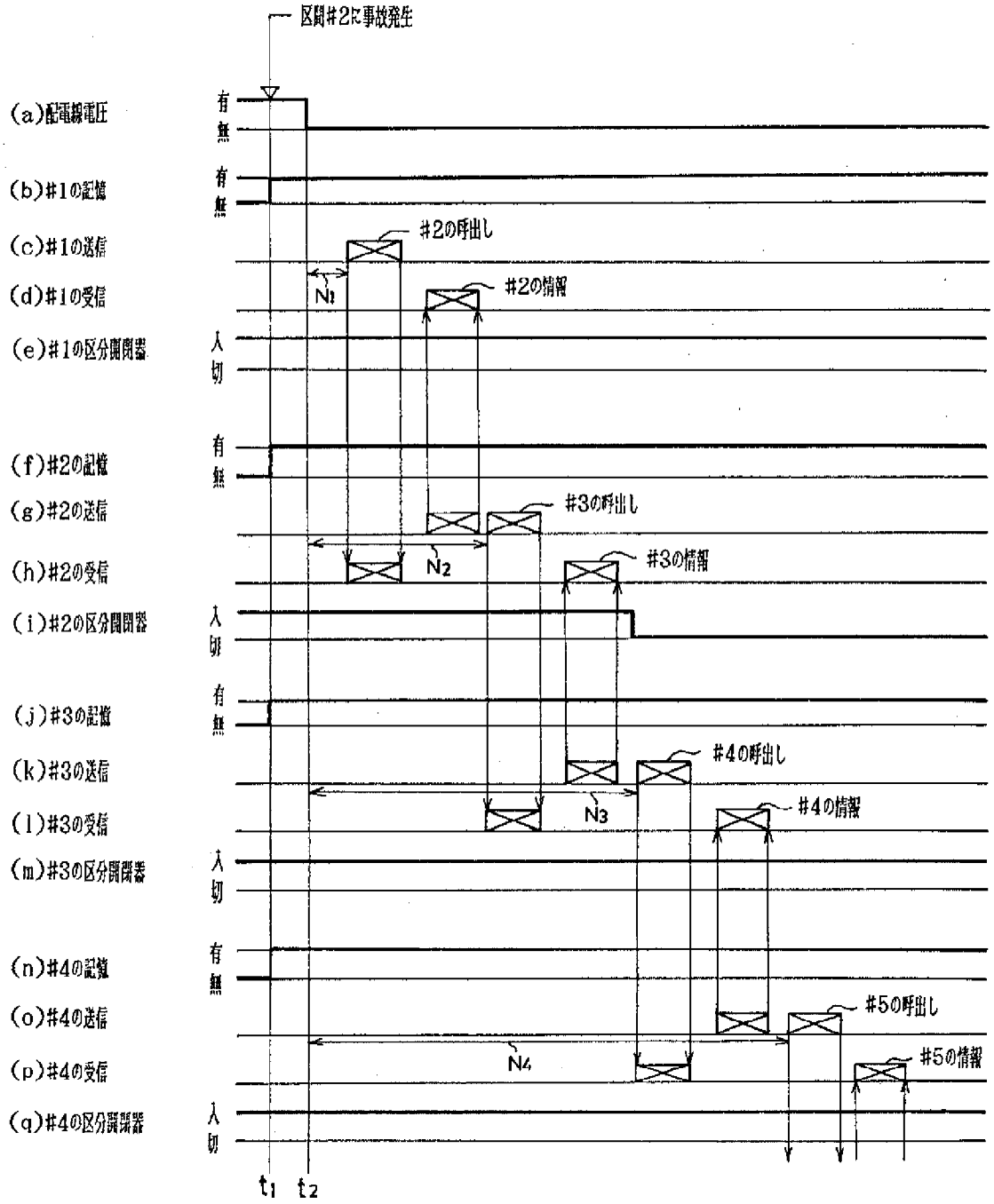
[Drawing 2]


スタート
ウ
イ
S1
初期設定
S2
A，C相間の線間電圧の把握
S3
各相の電流のベクトル和から
零相電流を求める
S4
零相電流
が設定値をこえたか
（過電流か）
NO
YES(地絡事故)
S6c
YES
Sa
Nn＝0か
NO
Sb
Nn←Nn－1
Sc
Nn＝0か
NO
YES
Sd
位相差の記憶のリセット(消去)
S6a
A，C相間の線間電圧と零相電流
との位相差の記憶
S6b
リセットカウントメモリのNnをセット
S5
系統電圧は消失しているか
NO
YES(停電発生)
ア

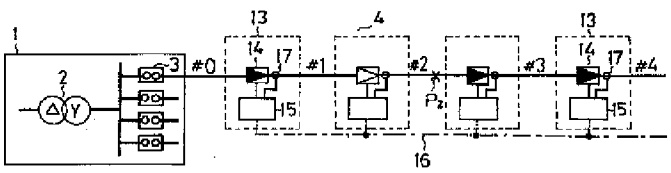
[Drawing 3]


ウ
ア
イ
S7
零相電流は設定値より大きいか
NO
YES
S8
Ni秒タイマのスタート
NO(復電)
S9
系統電圧は消失しているか
YES(停電継続)
S10
上流側次区間の装置から呼出されたか
NO
YES
S11
上流側次区間の装置への応答信号の送出
S12
Ni秒経過したか
NO
YES(待機時間経過)
S13
負荷側次区間の装置の呼出し
S14
負荷側次区間からの応答信号の受信
S15
自区間の位相差の記憶値と負荷側次区間の位相差の記憶値との差の絶対値は90°より大きいか
NO(他区間事故)
YES(自区間事故)
S16
区分開閉器の開放制御の実行
S17
系統電圧は消失しているか
NO(復電)
YES(停電継続)
S18
上流側次区間の装置から呼出されたか
NO
YES
S19
上流側次区間の装置への応答信号の送出
(停電継続)
S20
系統電圧は復旧したか
NO
YES(復電)

[Drawing 4]



[Drawing 11]



[Drawing 12]

(a)

SYNC	AD1	AD2	ID	DAT	END
同期信号	相手先アドレス	送信元アドレス	情報種別	情報(データ)	情報フラグ

(b)

SYNC	AD1	AD2	ID	DAT2	DAT3	END
同期信号	相手先アドレス	送信元アドレス	情報種別	情報(データ)	情報(データ)	情報フラグ

[Drawing 17]

#1の装置から#2の装置への呼出し

(a)

	#2	#1	(呼出し) 00000001	(状態情報要求) 00000011	
SYNC	AD1	AD2	ID	DAT1	END

#2の装置から#1の装置への応答

(b)

	#2	#1	(応答) 00000010	(状態情報) 10000001	(位相差情報) 00001100	
SYNC	AD1	AD2	ID	DAT2	DAT3	END

[Drawing 18]

#2の装置から#3の装置への呼出し

(a)

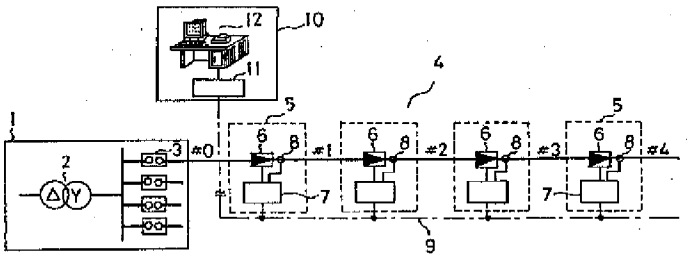
	#3	#2	(呼出し) 00000001	(状態情報要求) 00000011	
SYNC	AD1	AD2	ID	DAT1	END

#3の装置から#2の装置への応答

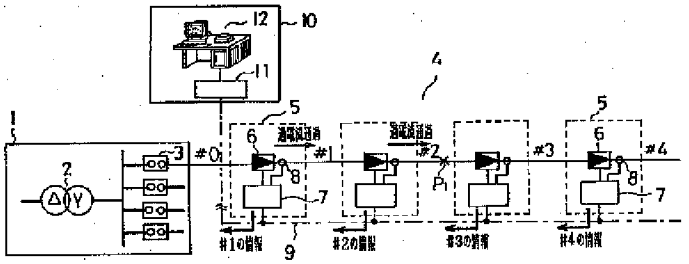
(b)

	#2	#3	(応答) 00000010	(状態情報) 10000001	(位相差情報) 10101100	
SYNC	AD1	AD2	ID	DAT2	DAT3	END

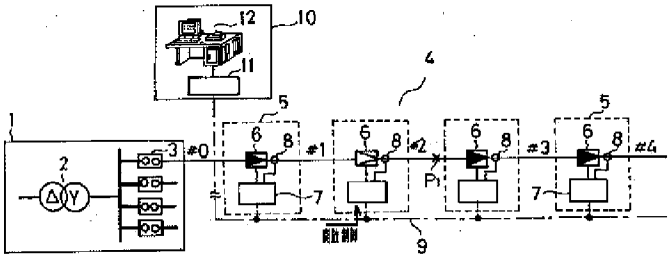
[Drawing 19]



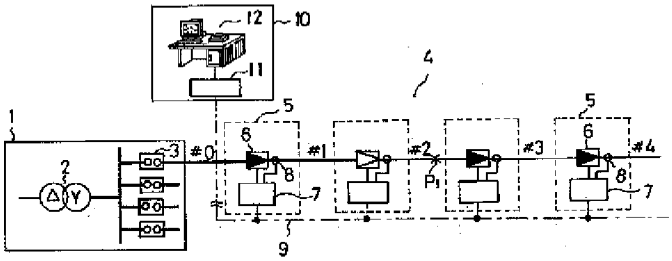
[Drawing 20]



[Drawing 21]



[Drawing 22]



[Translation done.]